IDENTIFICATION OF ORGANISATIONAL PATHOLOGIES: EXPLORATION OF SOCIAL NETWORK ANALYSIS TO SUPPORT THE VIABLE SYSTEM MODEL DIAGNOSTIC

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ABSTRACT

*While social network analysis has become a popular tool to understand social relationships at work, there aren't many reported cases in the literature on how to more robustly use these analyses to identify structural pathologies in organisations.*Here we suggest to combine Social Network Analysis (SNA) and the Viable System Model (VSM) diagnosis, to identify organizational pathologies. We suggest a heuristics to integrate these two theories and associated tools; and an example of how to use it, from a well-documented Action Research project, which included participative methods for VSM diagnosis, and questionnaires for collection of connectivity data for SNA. We prove that by following it, we can do more insightful VSM and SNA diagnostics and also more clearly identify of organizational pathologies. This enhanced way for identifying organizational pathologies can contribute to the emerging new interest in applications of the VSM in management, by providing even more robustness to the structural analysis of organizations. The document then opens new avenues for the study of organizational pathologies, and invites to a discussion of further and more advanced applications on the integration of the VSM and SNA.

Keywords: Organizational pathologies, Viable System Model, Social Network Analysis,

1. INTRODUCTION

The Viable System Model (VSM) was created by S. Beer more than three decades ago as a framework to design viable organizations. It is based on principles of self-organization, and complexity management from Ashby (1962); the theoretical foundations of neural networks from McCulloch (1945) (Beer, 1979; 1981; 1985; 1989) and the pioneering work from Bavelas (1950) on social networks (Beer, 1979).

The VSM provides a description of the necessary and sufficient patterns of dynamic interactions that should exist between the different types of roles and functions of an organization to be viable. Such roles/functions are presented as a recursive collection of related systems which in generic terms are described as:

System 1 (S1): in charge of the operations (all working teams directly responsible for products or services), which are in direct interaction with the environment.

System 2 (S2): In charge of anti-oscillatory functions for S1s interactions; it aims to avoid conflicts and to optimize and coordinate their interactions.

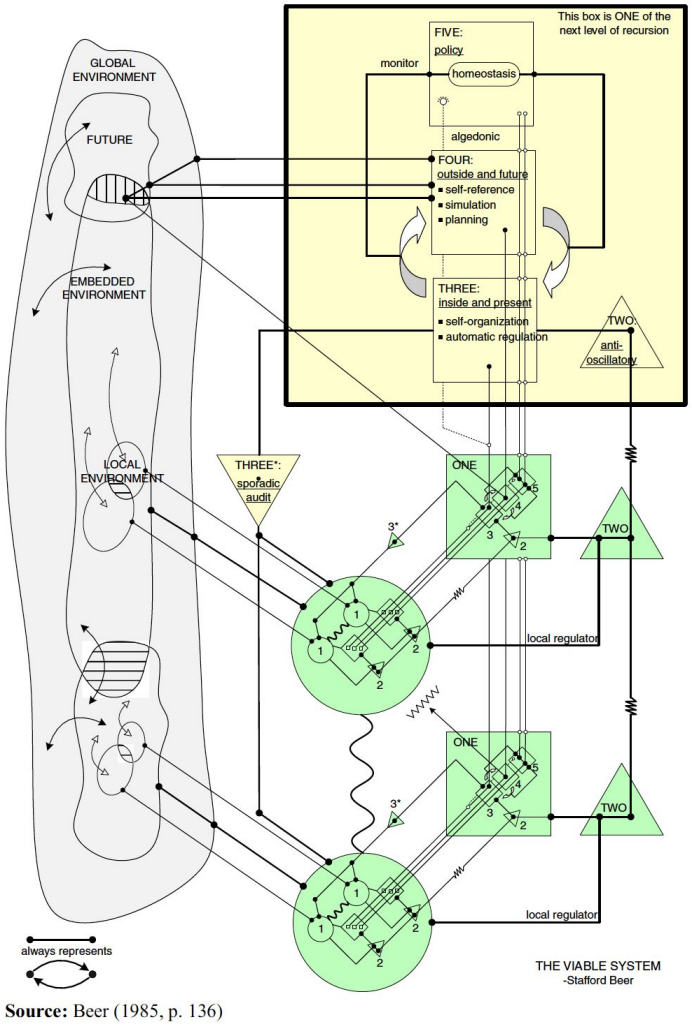
System 3 (S3 and 3*): It coordinates resources distribution among the S1s, generates synergies among them, and audits their activity - via system 3*. In Beer's terms: it is in charge of the here and now of the operations.

System 4 (S4): in charge of the constant monitoring of the external (general) environment. In Beer's terms: it oversees the outside and then of the organization. It acts close to system 3 to create and implement organizational adaptive responses to the environment (strategy).

System 5 (S5): Provides systemic closure to the whole organizational system, by being in charge of the definition of identity, ethos, policy and generic rules that govern the organization. It monitors closely the interactions of the S3 and S4 making sure that strategic alignment exists in the decision-making process.

The representation of the VSM and the suggested connections between its components can be seen in Figure 1. Beer (1985) suggested some general guidelines on how to use the VSM for diagnostic purposes: he recommend to start by defining the identity of the organization; identifying the levels of recursive organisations and then -at each level- mapping the

different VSM systems; being the final stage in the diagnosis the interpretation of results- including the identification of organizational pathologies, described by Beer (1989) as deviations from the model of connections, roles and functions of the VSM.



Source: Beer (1985, p. 136)

Figure 1. Description of the VSM (Modified from Beer, 1985. p 136): Note the allocation and interconnection of the different roles/functions and systems - VSM components. The figure also shows the recursive structure of the VSM inside the S1s - see the replica of the VSM within the S1s (green).

In the last decades the VSM has captured the attention of practitioners, researchers and academics, the increasing number of publications with applications in different organizations worldwide shows a renewed interest in the potential of the VSM to deal with contemporary issues in management (i.e. organizational performance, change and adaptation; knowledge management, complexity management, resilience, corporate governance, sustainability). This renewed interest on the VSM include works exploring its integration with other well established systems and complexity approaches like Systems

Dynamics (Schwaninger 2009); Complex Adaptive Systems (Espinosa and Walker, 2011); and Social Network Analysis (Watts, 2009, 2010; Knowles, 2009, 2010; Cardoso, 2011, 2015 and Al-Hinai et al, 2015, 2018). There are also new reinterpretations of the original VSM framework as the 'Viable Systems Approach' (Barile, 2009; Golinelli, 2000), also suggesting the use of network theory to analyze dynamic complexity- in the sense of constant change.

Within this emerging body of literature there are some relevant contributions to progress in the diagnostic of organizational pathologies, like: Brocklesby and Cummings (1996); Devine (2005); Schwaninger (2009); Hoverstadt (2009); Gmur et al (2010); Barile and Polese (2010); Espinosa et al (2010); Christopher (2011), Espejo and Kuropatwa (2011); Espejo and Reyes (2011); Perez-Rios (2012); Preece et al (2012); Espinosa and Walker (2011, 2013, 2017); Espinosa et al (2015); Cardoso (2011, 2014, 2015). In general, these contributions are limited to descriptions and/or classifications of organizational pathologies (e.g. identity and structure; communication).

Despite the renewed interest in the VSM - which seems to be one of the most robust theoretical and methodological frameworks to explain the management of structural complexity (Bohorquez and Espinosa, 2015); there hasn't been any substantial methodological development on how to identify organizational pathologies, beyond the descriptions and classifications provided by different authors, which rely on the expertise of the analyst/consultant doing the VSM diagnostic.

In this sense, to contribute to a more robust study of organizational pathologies, this work suggests a path for the integration of the VSM and SNA analyses as a heuristics to guide the observations of the patterns of interactions between the social networks that constitute the daily life of organisations. We describe a way of observing patterns of interaction between different types of roles/functions; initially mapping them through a VSM diagnosis and then using SNA, and a structured way to reflect on them and to validate the combined analytical findings.

To ease such analysis, we have created a compendium of the pathologies found in the VSM literature, including some identified through our own experience using the VSM - see *Appendix A*. In this compendium, we followed Espejo & Reyes (2011)'s original classification of pathologies - identity and structure - where Identity Pathologies are related with what the organisation does: their self-perception vs. their stakeholders' perceptions of its doing;

and Structural Pathologies are those that refer to how 'cybernetically sound' are the particular organizations regarding the management of complexity at different structural levels. We present the structural pathologies organized according to where they occur within the VSM. We also present examples of the use of this tool, in the EEC case study.

2. METHODOLOGICAL FRAMEWORK

2.1. VSM and Organizational Pathologies

Some pioneering systemic researchers suggested originally the idea of organisational archetypes. Senge (1990) developed this concept from the work of Argyris & Schon (1978) to explain certain patterns of relations between structural variables that would result in stereotypical behaviours that he called 'archetypes'. He described 12 systemic dysfunctions – archetypes – in his book 'the 5th discipline'. From an organisational cybernetic perspective, the description of organizational systemic dysfunctions have been structured through the use of the VSM with diagnostic purposes and presented as "organisational pathologies" by different authors (e.g.: Beer, 1989; Schwaninger, 2007; Espejo, 2008; Hetzler, 2008, Pérez-Ríos, 2008; Hovestadt, 2009; Espejo & Reyes, 2011). Despite this continuous theoretical and empirical developments, there aren't (as far as we know) specific analytic routines to identify and study such pathologies rather than theoretical descriptions based on the expertise of the analyst or consultant.

2.2. Social Network Analysis

With a long tradition in fields such as sociology and epidemiology, SNA has been increasingly used in organisational studies. Moving from pioneering applications to empirically explore the structure of groups (Bavelas, 1950); to the exploration of its potential in the development of organisational theory (Tichy et al, 1979), the use of SNA in management has developed towards advanced specific applications. For instance: the analysis of power (Brass, 1984; Burkhardt and Brass, 1990), communication (Monge and Eisenberg, 1984), or innovation (Burt, 1987; Rogers, 1985); and more recently with a more pragmatic application as a diagnostic tool, the work of Krackhardt and Hanson (1993) exploring the incidence of informal networks in management.

In consequence, the SNA has developed different approaches to observe the nature and

properties of social networks. A practical summary of these approaches and related terminology can be found in table 1.

Network Properties	
Property	**Attributes**
Transactional content	Affect, influence, information, goods/services
Nature of the link	
Intensity	Strength of the relation between two individuals
Reciprocity	The degree on how two individuals reciprocate each other interaction (e.g. degree of symmetry)
Multiplexity	The degree in which an individual is connected by multiple relations
Structural Characteristics	
Size	The number of participants in the network
Density (Connectedness)	Number of actual links as a ration of the number of possible links
Segmentation	Refers to the number of dense regions in the network (communities, cliques, clusters)
Centrality	Refers to the extent to which an individual interacts with other individuals in the network
Bridge	A individual who connect two other individuals or clusters in the network
Gatekeeper	Refers to individuals that connect the network with external domains
Hub	Individual with the highest number of connections inside the network.
Network Measures	
Degree centrality: Measures the number of connections a particular individual has with other individuals, and is the sum of the links in and out of the individual. It can consider three calculations: In-Degree (considering just incoming connections); Out-Degree (considering just outward connections) and Total-Degree (the total of in and out connections). *Interpretation note*: *High degree can be related to individuals with influence in the network and/or to know and diffuse information. A high out-degree may identify hubs; whereas high in degree may identify experts.*	
Closeness: Measures the sum of the geodesic distances to all other individuals - geodesic is the shortest path between two individuals. *Interpretation note: High closeness value usually identifies individuals who are good sources of information and also useful for the diffusion of information*	
Betweenness centrality: Measures the extent to which an individual lies on the geodesic path between other individuals in the network. It reflects the number of people with whom a person is connecting indirectly through their direct links. *Interpretation note: It identifies brokers of information (knowledge or resources). It relates to power and can lead to areas of vulnerability as individuals with high betweenness can be exposed to high stress and vulnerability due to the brokerage activity.*	
Eigenvector centrality: Measures the extent to which an individual is connected to other highly connected or important individuals. *Interpretation note: This measure indicates emergent leadership in social networks. It identifies individuals who are key to make things happen due to their knowledge and connections with other important (well connected) individuals in the network.*	
Network Density: Measures the total actual number of links in the network as a proportion of the total possible links. *Interpretation note: Low density may suggest little collaboration and communication within the network; a probable sign of low level of shared objectives and common goals.*	
SNA Analysis Methods	
Positional analysis: Based in the use of the formal organisational data (formal communication channels/influence). It reflects prescribed communication/reporting lines.	
Reputational/Attributional Analysis: It attempts to issues of power by using judgments of selected community members as to "who are the top leaders" or "who are the most influential persons in your community. Taps only perceived networks and is susceptible to built-in status bias often. However relatively simple to do, it has been questioned by the reliability of data	
Decisional Analysis: It concentrates its attention on the identification of participants in the decision-making process of select/specific key issues, reconstruct the social network and then appraise relative influence. It has been criticized by the difficulty to define the key issues, complexity and neglect of the non-decision making process	
Interactional methods: The central focus is the observation of the flow of interactions (or influences) and their feedback. The network can be created from either time series or single-point surveys administered to the whole system. Individuals are asked to report their interactions or influence attempts over the period studied and for particular content areas. With these data, interaction nets and power relations can be determined. the use of real-time and non-intrusive methods of data collection. It has been criticized for its assumption of closed systems and the need of high response rates during the data collection.	

Table 1. Summary of Network properties. The table also lists some of the most used network measures in management.

In general the SNA in business studies typically uses interactional methods with measurements of Centrality such as Degree Centrality (with observations on the in-degree and out-degree to detect concentration in the flows of information and eventually, issues of power and influence); and Betweenness, to identify brokers/gatekeepers as suggested by Freeman (1979, 1989), Freeman, et al (1980) and Borgatti, Everett and Freeman (1999). Also, Eigenvector Centrality and Closeness, together with global indices of Reciprocity and Density to estimate changes through time in the structure of the network, individuals with high values of popularity, and/or individuals with high connectivity within a particular clique, as suggested by Ortiz-Arrollo & Hussein (2008), Cheliotis (2010) and Newman (2010).

More recently, advanced use of these basic centrality measures takes advantage of high computational power allowing the use of sophisticated meta-matrices. An example of it is the development of the Organisational Risk Assessment tool (ORA) for defence and anti-terrorism purposes (Carley & Reminga, 2004). The ORA tool uses a meta-matrix that combines networks of relationships between people, knowledge, resources and tasks/projects. Armstrong and McCulloh (2010) highlight that ORA does not have many documented applications in business and they provide a basic guideline for its use in management. From a different approach, Easley & Kleinberg (2010) present a description of the SNA routines frequently used by researchers coming from modern complexity sciences to analyse the dynamics and structure of social networks. However powerful these sort of analysis have demonstrated to be, there are little insights coming from them about the specific identification of organisational pathologies (in this context, perhaps the closer one is the ORA and the identification of organisational risk and vulnerable links/nodes); hence, the contribution of this paper.

The following section describes the integration of VSM and SNA. We explored the use of some basic measures of centrality (e.g. Degree and Betweenness as they are the most commonly used).

2.3. The combined use of VSM & SNA

The works of Watts (2009, 2010), Knowles & Espinosa (2009), Knowles (2010), Cardoso (2011, 2015) and Espinosa et al (2011) constitute the background of the integration of VSM

and SNA. These studies state that in general, the integration of SNA and VSM is feasible based on the fact that both can be understood as representations of the many different communication channels connecting key roles/functions within an organization. Initially, the SNA was used to illustrate how communications channels were adequate to manage complexity (particularly at the VSM Meta–systemic levels – Watts, 2010). Later on, the SNA was used to describe the completeness and adequateness of connections at the time of designing a management system (Knowles & Espinosa, 2009). And more recently, to add to these observations a quantitative analysis of the flows of information, aiming to identify the presence of key nodes and how do they relate with key functions/roles within the VSM structure (Cardoso, 2011; Espinosa et al, 2011; Al-Hinai et al, 2015, 2018). To continue with this research direction, we develop a thought experiment (Davis and Kerr, 1986; Brown, 1986; Brunzl, 1996); based on the work of Cardoso (2011) and Espinosa et al (2011) grounded on the following rationale: We understand that the VSM provides a theoretical framework – describing critical reporting channels and associated roles and functions that would create proper conditions for organizational viability: any deviation from such theoretical model suggests the existence of an organizational pathology. On the other hand, SNA can provide from a qualitative and quantitative perspective a description of all the connections within the organization in all its richness (depending on the quality of the dataset) and can identify individuals performing key roles/functions within the social network (e.g. hubs, gatekeepers, experts). It can also describe the intensity, direction, and strength of existing links as well as the identification of structural features such as the existence of groups and their connectedness.

Therefore, as the VSM framework allows us to map the different types of structural connections, to evaluate their functionality, and how appropriately each one deals with complexity: by using this as an analytical filter we can identify structural pathologies in the way of managing complexity. If we superimpose on this (VSM) mapping, the information and the different structural representations of the organization coming from the SNA - by identifying social networks patterns and clearly relating them to the VSM components and levels of recursion - we can validate the observations already made through the use of the VSM analysis from a complementary (quantitative based) analytical perspective. This combined analysis can offer more evidence of those reported pathologies related to structural features such as the presence/absence of key links, the concentration or lack of

communications in a particularly key role/function, and the presence or absence of groups (defined by their connectedness in the SNA) linked to a key activity (a VSM system 1-5).

We propose a three stages process in which the first stage for the VSM & SNA integrated analysis is the VSM diagnostic. For this purpose, in this work, we follow the VSM methodology proposed by Espinosa and Walker (2011, 2013) and Espinosa et al (2015). It suggests a first step as the definition of boundaries and identity of the organizational system; followed by the identification of recursive levels of organisation; the identification of structural issues; provision of structural solutions and implementation and monitoring. In this work we concentrate on the identification of structural issues; once the VSM diagnostic is complete - in this stage we recommend the adoption of a multi-methodological framework adding the use of longitudinal and narrative analysis for the contextualization of observations and results (both, for the VSM and SNA) as previously suggested by Cardoso (2011) and Espinosa and Walker (2013). The findings on structural issues are presented in a VSM diagram (see figure 2), and in a table describing the organisational pathologies found - based on the list of pathologies presented in appendix 1.

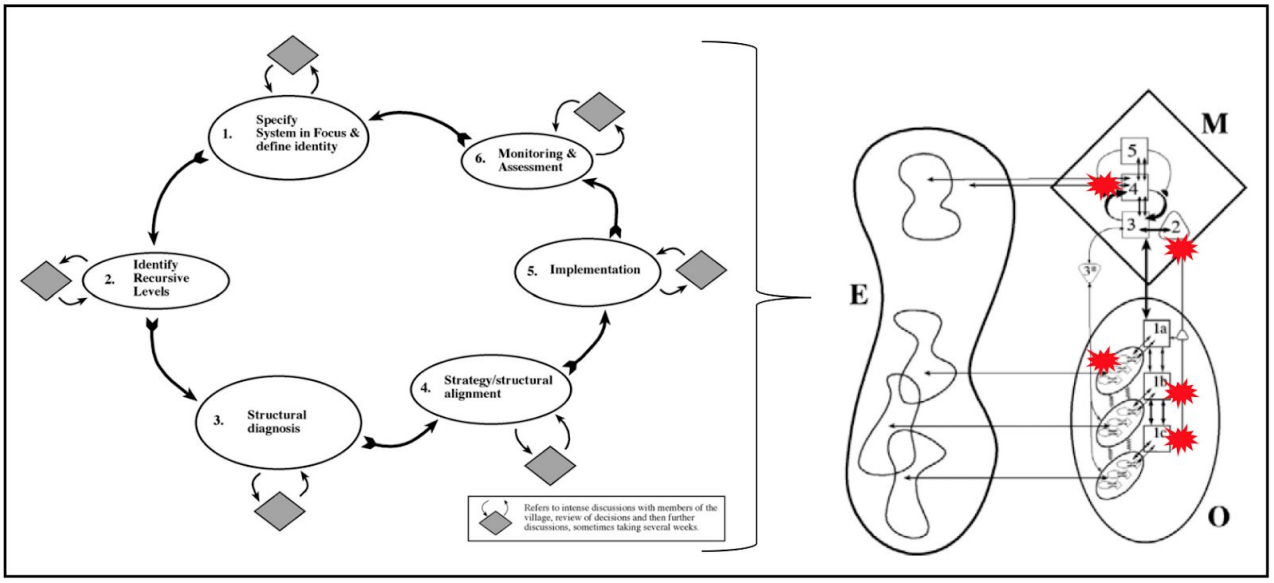


***Figure 2*. VSM Diagnostic** (Modified from Espinosa and Walker 2011). The result of the VSM diagnostic is the mapping of organizational pathologies - graphically presented in red in this figure.

Simultaneously to the data collection for the VSM diagnosis, the SNA data collection occurs (in our case, via questionnaires); it provides information to identify key individuals and clusters and to generate a graphic representation of the network, which is then codified as a

table using the selected metrics. In this study, this analysis was assisted with the use of UCINET (Borgatti et al, 1999). At this stage, the graphic representation of the network may provide the option to simultaneously visualize the network structure and the values of the selected metrics for each individual (in our case, Degree and Betweenness).

The next stage is the integration of results. For this purpose, the SNA results are superimposed in the VSM following the next sequence:

1- SNA identification of key individuals based in their high values of connectivity and structural position in the network e.g.: hubs, gatekeepers, experts, bridges. We would expect to find coincidences with VSM key roles/functions such as managerial/coordination roles, and links between VSM components - via direct connection of (preferably) key individuals and/or bridges.

2- SNA Identification of clusters - an optional routine would be the superposition of such clusters in the VSM diagram. In this step, we would expect coincidences in the affiliation of individuals to clusters with VSM components as registered in the VSM diagnosis. The SNA analysis would allow us to deepen into some communication pathologies related with the cohesiveness and conectiveness of such identified groups.

3- Consolidation of values of connectivity for each VSM component. Based on the registered affiliation of individuals to VSM components, we can consolidate and compare their values of connectivity against the mean value of the network. If compared with the results from the previous stage it will allow us to identify each one of the VSM systems 1-5 with flows of information/activity that may suggest abnormal behaviours - such as consolidated connectivity values extremely distant to the mean value of the network. To simplify the graphic representation of this data, colour codes to identify key VSM systems and individuals and their connectivity values can be used (see figure 3).

4- Comparison of findings from the previous stages with identified pathologies in the VSM diagnosis . In this stage data from the longitudinal analysis (if applicable) will contribute to the sense-making of coincidences or discrepancies detected in the VSM-SNA integration. This comparison of results may also conduce to the final identification of pathologies with the possible inclusion of new unseen ones. The complete integration process is illustrated in figure 3

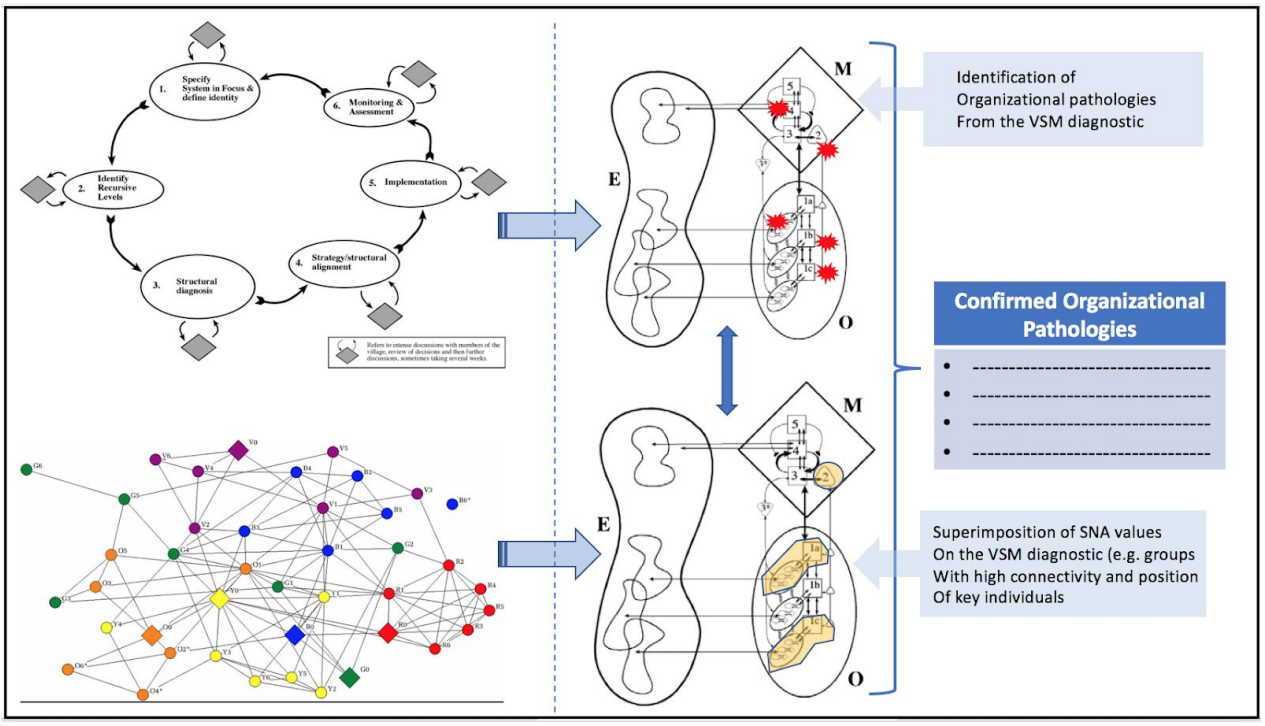


***Figure 3*. VSM & SNA integration.** From left to right the stages of integration can be observed. Note in the top right the VSM process running simultaneously with the SNA (Bottom left). Also the SNA capacity to identify key actors and groups - represented by colour and shape of nodes.

The next figure (figure 4) assuming the existence of a previous SNA and VSM diagnosis illustrates the final graphic representation of the integrated VSM & SNA analysis. Here we can observe that two systems one do not concentrate high values of connectivity and they don't have a connection with the S3*. Also, not all the S1 are well connected to the S2 and just one of the S2 roles (ironically the one not linked to any S1) present a high value of connectivity (triangle shadowed in yellow). We can also observe that the S3 is not well connected with the S1.

The final identification of pathologies links the diagnostic points identified with some of the pathologies described in *Appendix A*. In the figure we can identify: Weak Connection Between S3 and S1; Lack of Sufficient Development of S3*; Dissociated Behaviour within S1; Autopoietic beast (S1 with high values of centrality but poor connection with meta-systemic functions); Lack of Algedonic Channels; Lack of Communication Channels; Lack or Incomplete Connections between S1 and S2; Lack or incomplete Connections between S3 and S1; and Insufficient Communication Channels Capacity.

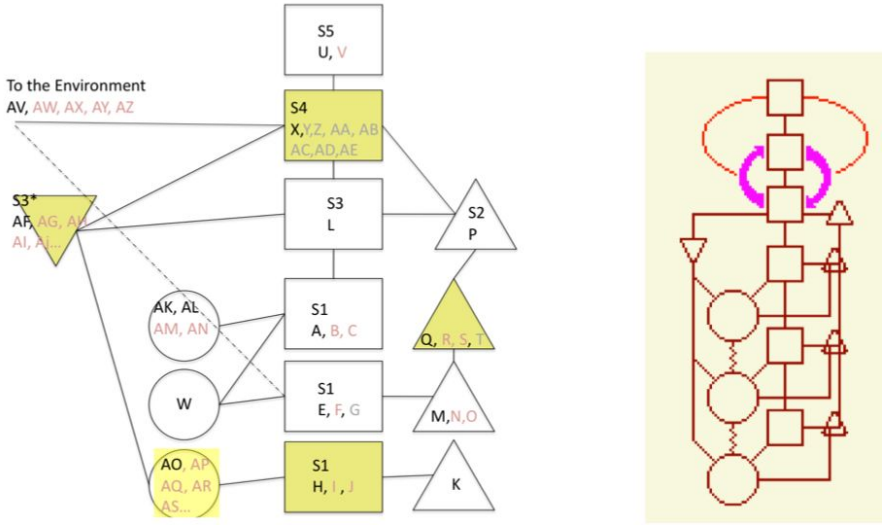


Figure 4: VSM-SNA integrated: In the figure, individuals are represented by capital letters (Red/amber represents individuals with high values of centrality). The VSM systems concentrating high values of connectivity are highlighted in yellow, and strong links between groups are represented as lines connecting the different VSM systems. This information is compared to the connections in the VSM mapping (theoretical model - diagram on the right) and the differences will suggest the presence/occurrence of an organizational pathology.

As this observation can be done in a longitudinal basis using data from time series, it would offer the possibility to observe not just structural but also dynamic organizational change and complexity - to keep simple this initial explanation on the integration of SNA & VSM this paper does not develop further on that direction.

3. APPLICATION

3.1. The case study - Organisational context

Working within the context of an EPSRC funded project 'Defying the rules: how self-regulation works in social systems', the authors used the above-combined framework to support a process of self-transformation in a European Eco-Community (EEC). Based on self-organisation principles the EEC aimed to build their eco-houses and to remain as a democratically self-governed organisation. They developed an eco-charter as a statement of their identity and principles, and it was used as a guideline for their decision-making processes. At the time of the academic intervention they were facing several events that were threatening their organisational viability (e.g. economic collapse of the country and no credit available for development projects; failure in the application to the local council; project members increased to the peak of the project - 120+ families; beginning of engineering and building works in the field challenging the nature and function of the

management, among others). During 2007-2010 the authors were actively engaged in an action research project at this EEC: first, supporting a process of self-organisation using a VSM inspired methodology (see details in Espinosa & Walker, 2011, 2013 and Cardoso, 2011); and then in observing and analysing the dynamic co-evolution of social networks during the period of the VSM intervention (Cardoso, 2011; Espinosa et al, 2011). The next sections illustrate the stages in the application of a combined VSM/SNA; including notes on how this can be linked to the identification of organisational pathologies.

3.2. First Stage: The VSM of the EEC

The academic intervention started with the VSM diagnosis through a series of workshops involving all the EEC community. As a result of this process, the structural problems detected were mapped in a VSM diagram (figure 5). Among the findings it was noticeable for instance the numerous working groups - VSM "Systems 1" - whose complexity have proven to be unmanageable; the isolation of many of them and the consistent lack of monitoring on the activity of the operative groups. The Figure 5 below provides a complete visual representation of the organisational problems found at that time of the VSM diagnostic of the EEC.

The findings, in turn, were presented in a report including a table (Table 2) containing a summary of some of the key structural issues identified. The table presents a column relating each diagnostic point, organized according to its locus in the VSM, and a list of the related organisational pathologies for which the diagnostic points are symptomatic

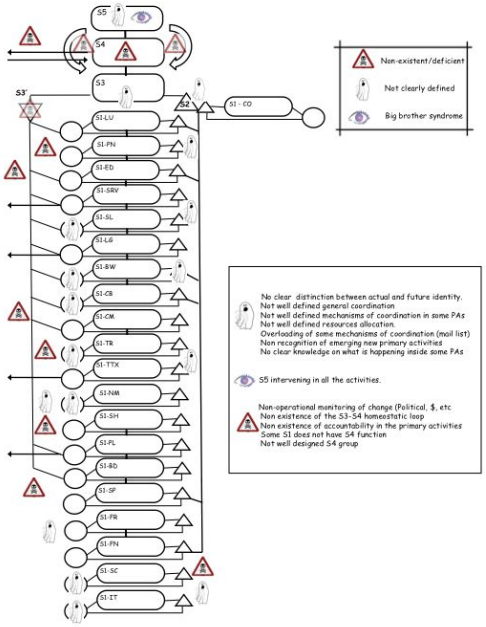


Figure 5. VSM of the EEC (2007): To simplify this graphic the amoeba-shape diagram that represents the environment has been omitted. The icons around the different systems describe some elements contained in the diagnostic as presented in the right box with a direct link to organisational pathologies.

VSM Component	VSM Diagnostic	Pathologies
System 1	- Workgroups, defined by members' interests. - Inconsistent performance. - Meetings and monitoring sporadic. - Unreliable Coordination. - Sporadic and unstructured reports - Some work done by Board intervention.	- *Poor (or no) differentiation of primary and secondary activities* - *Disjoined behaviour within S1s* - *Weak S1*
System 2	- Lack of shared information between working groups. - Informal meetings at social events, timetables. - Lack of reporting standards.	- *Lack of information systems* - *Lack of key communication channels*
System 3	- Fragmented. - Carried out by the Board, the Administration Group, the Coordinators Group, the Legal Issues Group, the Road Map Group and the Process Group - Inability to detect incipient crisis (i.e. financial)	- *A collapse of System 5 into System 3 (non-existing metasystem):* - *Weak connection between S3 and S1* - *Hypertrophy of S3* - *Lack of sufficient algedonic channels*
System 4	- Fragmented and unfocused. - Carried out by The Board, and diverse disconnected work groups	- *Headless Chicken*
System 5	- Policy defined by all-members meeting	- *Lack of meta-system*

Table 2: VSM diagnostic - Identification of organisational pathologies. The table summarises the findings of the VSM diagnostic and relates the findings with the organisational pathologies listed in Appendix A.

3.3. Second Stage: The SNA of the EEC.

By adopting an interactional method (as described in table 1), data about the evolution of the organizational structure, networking of the individuals and performance of the operative units, was collected during the academic intervention at different moments of time. The methods used for that purpose included interviews, questionnaires and in-field direct observations. In each of the observation events, the data was consolidated summarizing the previous three months of (networking) activity in the EEC. In this case, we will present just the first of such observations.

The data collected was used to create an undirected network to run analytic routines using UCINET (Borgatti and Freeman, 1999) in which a tie in any direction is counted as a tie. The values for degree and Betweenness were included in the visualization of the network to identify key actors (as suggested by Ortiz-Arroyo and Hussain, 2008; Cheliotis, 2010). To provide context to the network and VSM diagnoses, a longitudinal analysis was also conducted aimed to detect patterns in the narratives and to identify critical events; usually related with shifts in the organizational structure and the dynamic of the social group as

suggested by Webster & Mertova (2007). Figure 5 shows the topography of the network – generated with UCINET – were both values of Degree and Betweenness are presented graphically (values and node size).

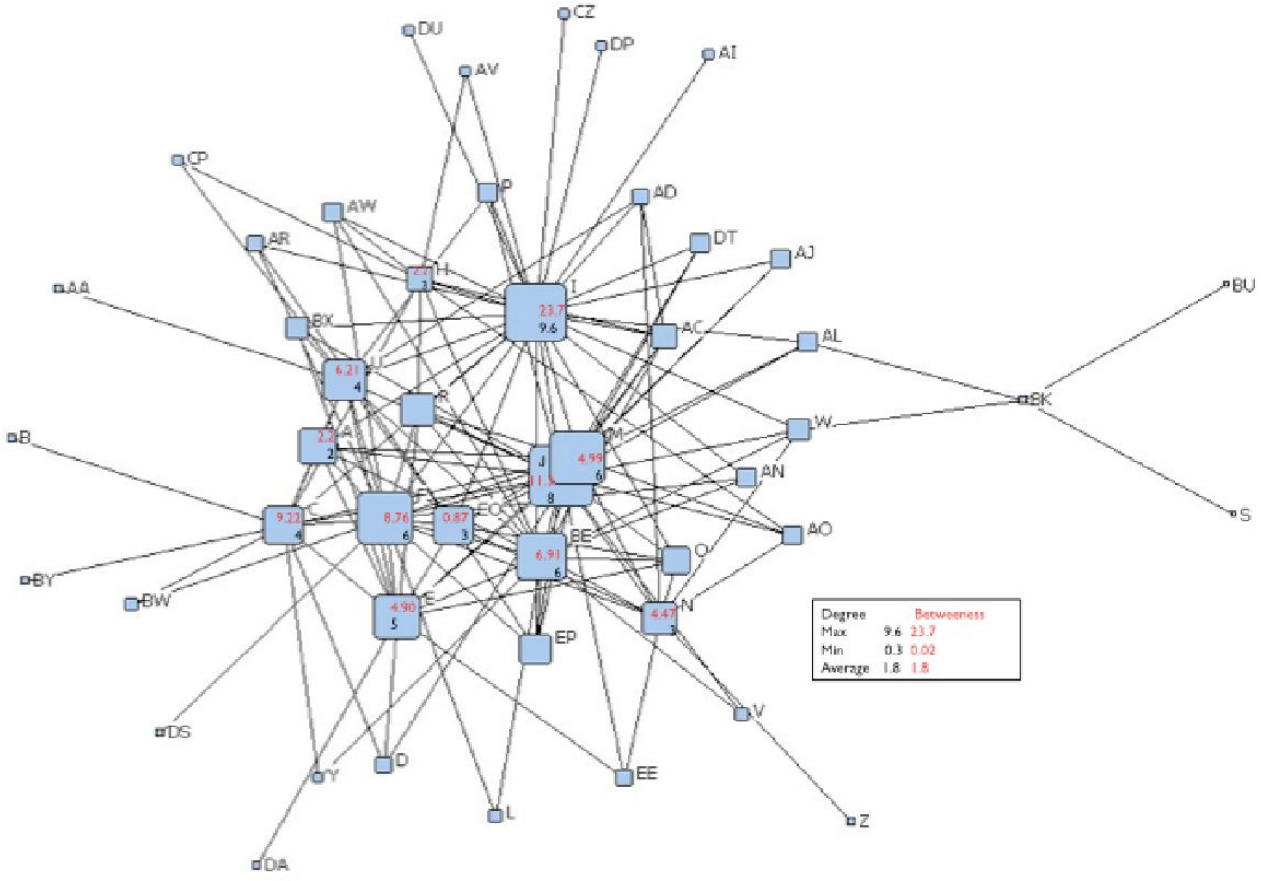


Figure 5: Degree (2007). The node size represents the value of total degree. Inside the nodes are the values of Degree and Betweenness of the identified key actors – Those whose high values of Centrality (Degree, Betweenness) Notice the cases of **M, J, I, F, BE, N** and **U** and the coincidence of the high values of centrality of these individuals with their role/function as leaders of operatives group (VSM –S1) or in the secondary activities (VSM – S2,5).

After obtaining the raw network the next step was the identification of cliques/groups/communities. In this case, due to the membership of individuals to multiple tasks/groups (e.g. Individuals N, BE, U – figure 6), we did not use the routines for this purpose in UCINET – a limitation of most of the SNA software discussed on Cardoso (2011); Espinosa et-at (2011). Instead, to integrate this information into the EEC's VSM we decided to use the consolidated values of Degree and Betweenness for the groups as reported in the affiliation to VSM systems (working groups) in the first stage of the diagnostic.

Once the values of centrality are consolidated for each VSM component, we identified in each group the key members - previously identified in the network as with the highest

values of Degree and Betweenness. The results of this grouping of data are presented graphically using the VSM template (Figure 6). By grouping the data with this procedure, we identified groups with high and low values of cumulated traffic of information/connectivity, key players and their position and relation with the key roles/functions within the VSM.

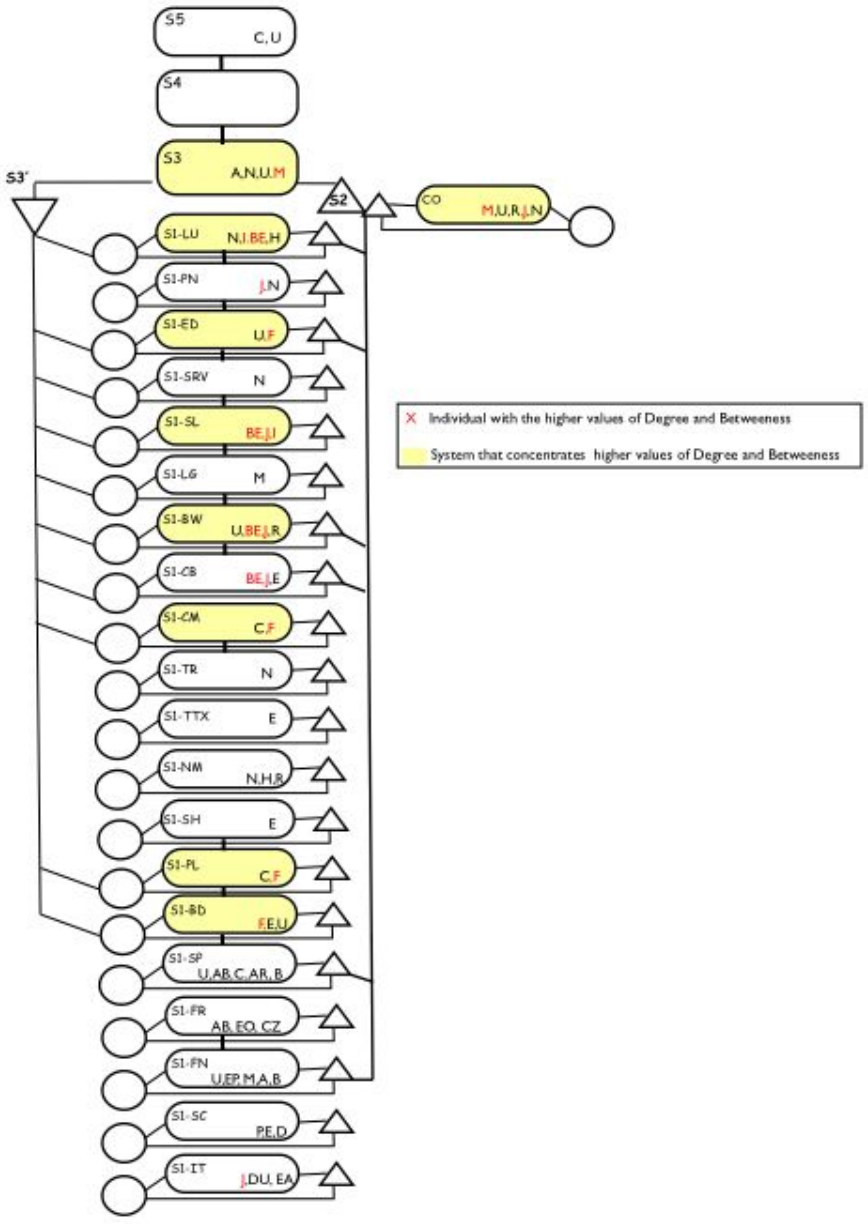


***Figure 6*. VSM and SNA**. In the figure, the individuals and tasks with the highest values of connectivity are identified – red letters and yellow fill respectively. To simplify this diagram, the environment (amoeba-shaped figure at the left in the previous VSM diagrams) was omitted. Note in this representation the misplacement of activities such as Political lobbying and Strategic Planning; Communications and IT; and Legal, Finances and Fundraising that should be placed in the systems 4, 2 and 3 respectively.

Finally, the identification of pathologies is revisited with this new information, where new interpretations are possible either validating previous observations or highlighting new diagnostic points. For instance, the individual **A** who acts as the CEO of the EEC does not have significantly important values of centrality; in general his connectivity is low and is not reported as with significant presence in the VSM system 5; or just a few VSM systems 1 have high consolidated values degree/betweenness indicating low flows of information (or low activity in general). These observations are summarized in a revisited version of the table identifying organizational pathologies (table 3); where the final report of identified organizational pathologies is presented.

VSM Component	VSM & SNA Diagnostic	Pathologies
Identity	- Organisational Identity dominated by few S1 - Operations not aligned with the EEC's identity	- *Underdeveloped primary activities* - *Negative Synergy*
System 1	- Workgroups, defined by members' interests. - Inconsistent performance. - Meetings and monitoring sporadic. - Unreliable Coordination. - Sporadic and unstructured reports - Some work is done by Board intervention. - No activity, poor connection with systems 2-5 - Difficulty to identify groups and embedded communities - individuals acting in several VSm systems - A group with a high concentration of activity not strongly connected with S2 and S3.	- *Poor (or no) differentiation of primary and secondary activities* - *Disjoined behaviour within S1s* - *Weak S1s* - *No Vertical Unfolding* - *Entangled vertical unfolding* - *Autopoietic beast*
System 2	- Lack of shared information between working groups. - Informal meetings at social events, timetables. - Lack of reporting standards. - Lack of links with several S1s	- *Lack of information systems* - *Lack of key communication channels*
System 3	- Fragmented. - Carried out by the Board, the Administration Group, the Coordinators Group, the Legal Issues Group, the Road Map Group and the Process Group - Inability to detect incipient crisis (i.e. financial) - Poor/Nonexistent connections with S1s - Lack of connections between S3* and some S1s.	- *Collapse of System 5 into System 3 (non-existing metasystem):* - *Hypertrophy of S3* - *Lack of sufficient algedonic channels* - *Weak connection between S3 and S1* - *Weak System 3**
System 4	- Fragmented and unfocused. - Carried out by The Board, and diverse disconnected workgroups - No group identified related to this role/function	- *Headless Chicken*
System 5	- Policy defined by all-members meeting - No detection of a group/community performing this function	- *Lack of meta-system*

Table 3: **Final Identification of organisational pathologies.** The table summarises the findings of the integrated VSM & SNA diagnostic and relates the findings with the organisational pathologies listed in Appendix A. The pathologies in red are the ones for which the SNA contributed with evidence to the identification of diagnostic points. Compare with table 2 to see the differences and contributions to the diagnostic using the SNA to enhance the VSM diagnostic.

4. DISCUSSION

4.1. On methodological improvements for supporting the organizational diagnosis

Given the renewed interest in the VSM and the increasing number of authors developing applications inspired on the VSM; in this work, we concentrate our attention on further clarifying the value of integrating VSM and SNA analyses, by offering a guideline to support the joint analysis for identification of organisational pathologies. This contributes to further structuring a VSM intervention: a) by offering a tool to reflect on diagnostic points by relating them to a comprehensive description of organisational pathologies; b) by making diagnostic decisions less dependent on the expertise of the consultant by introducing quantitative observations; c) by offering a method to link structural and dynamic complexity analyses in the VSM d) by providing a more structured evidence of the impacts of a VSM intervention in re-structuring patterns of connectivity between workers (Espinosa & Walker, 2013, p. 126-128).

4.2. On the use of the VSM to support information management

Following the discussion by Preece et al (2012) on how the VSM may impact the understanding of operative functions, we suggest that the integrated toolset and method of identification of organizational pathologies presented in this paper could add the following benefits:

Identification of Information Overload: Preece at al (2012) suggest that too much relevant information, if not filtered, may affect the viability of the system. Our integrated toolset offers more accurate criteria, to assess the capacity (conductance) and strength of the communication channels. This feature, combined with more advanced modelling tools (such as real-time SNA modelling combined with Narrative Analysis), could contribute to the early detection of bottlenecks and key actors in control of critical information in the organization as suggested by Carley et al (2007).

Feedback across systems: Preece et al (2012) discuss the importance of feedback among the S1, S2 and S3, and how a busy S1 will concentrate their resources and attention to the performance of the task rather than to communicate to S2 and S3. In our case, early detection of increasing communications within a S1 may conduce to the design of

contingency measures to ensure S2 and S3 will cope and be informed about the activity of the S1 (e.g. the variations on the connectivity in active groups such as Land Use, EWW, and Education in 2010 conducting to the emergence of spin-offs).

The method/toolset suggested in this paper offers a preliminary exploration of the potential to use a quantitative approach (SNA) to the identification of where and by whom the information is being processed in the organization – adding to what was suggested by Achterbergh and Vriens (2002) with regard to the use of VSM and information management. SNA provides a complementary quantitative approach that helps to identify where communication breakdowns may occur. This understanding of the dynamic of connections/communications offers an opportunity to use variety engineering to design more robust and resilient organizational re-engineering solutions and to assess organizational risk.

4.3. On soft OR and multi-methodology

The epistemological debate on soft OR research, has focused recently on issues on multi-methodology. Following Mingers (2006) and Mingers and White (2010), we introduce another example of a multi-methodological framework, which suggests a combined analysis at the individual and social levels. This relates to other recent developments using multi-methodology in soft OR (e.g. Mingers, 1997; De Tombe, 2002; Gondal, 2004; White & Lee, 2009; Hermans & Thissen, 2009; Namen et al, 2009; Howick & Ackerman, 2011). It offers an in-depth description of an intervention using mixed methods, that may help to develop our understanding of multi-methodology, as Howick & Ackerman (2011) recommend.

In particular, the paper reveals the power of combined VSM & SNA analyses to allow an in-depth observation and measurement of evolving communities at work. It offers a more precise indication – based on quantitative evidence - of certain patterns of social interaction, characteristic of VSM identified pathologies. We are aware that the SNA analyses only gave us extra evidence of the typology of interactions that characterise a certain pathology; not a precise or unique indication of such pathological behaviour. It offers, however, a more robust indication of the presence of pathological behaviours, and it may allow interested researchers to collectively build up a shared diagnostic knowledge base.

This exploration has proved that the SNA can importantly contribute to the identification of patterns of connections/ interaction. Nevertheless, due to the more quantitative nature of the analysis, it can not provide diagnostic information about more abstract issues such as the definition of organizational identity: softer analytical tools are required to explore this type of issue.

4.4. On assessing the impact of a soft OR interventions

Mapping the evolution of patterns of (self-organised) informal networks through a process of organisational change is an innovative and robust way to observe the dynamics of organisational change. As detailed in Espinosa et al (2011), it provided us with quantitative evidence of improvements in the connectivity patterns of the ECE and a clear way to relate those with VSM suggested directions of change. The joint VSM-SNA analysis left us with quantitative evidence of the root of some communication pathologies among the network of key agents leading a change process. Our multi-methodological toolset contributes to overcoming the reported 'lack of empirical evidence of effectiveness' of most soft OR methods – Vidal (2009), Ackermann (2012). It suggests a viable metric on the nature of perceived change in an organization that is self-organising, therefore conferring more robustness and validity to research using soft OR approaches- as Mingers (2011) has suggested. This research path has continued to produce outputs regarding the use of SNA and VSM as demonstrated in Al Hinai's research (Al Hinai et al, 2015).

5. Conclusions and open research paths

From our literature review of the recent research on complexity management, we found that most of the recent research developments are focused on observing patterns formation, mostly through social network analyses. Even if there has been clear interest from the OR community in understanding, observing and measuring organizational dynamics and the management of complexity, there aren't yet many well-known/ established methodologies that provide detailed guidance on how to do such analyses to support the identification of organisational pathologies; and on how to guide/drive solutions to improve complexity management.

We have detailed here an innovative methodological framework that develops existing VSM diagnostic tools in a direction that has been the focus of attention of contemporary research

in complexity management: how to observe and measure relevant aspects of the structure and dynamics of self-organising social systems and how to value organizational capabilities to manage complexity.

We have also illustrated how we can use this combined analyses for a) strengthening the diagnostic power of the VSM, by further studying organisational pathologies and capabilities to deal with complexity in working teams and networks; b) by demonstrating a way for investigating further some of the identified organisational pathologies that have been described by other researchers in the field. There are many references to VSM as a robust theory to explain structural complexity, including diagnostic methodologies and applications; also to SNA theory and applications. Even though, apart from Watts (2009, 2010), Knowles & Espinosa (2009), Knowles (2010), Cardoso (2011) and Espinosa et al (2011), we are not aware of other works explaining ways of combining studies of structural (VSM) and dynamic complexity(social network analysis), as this one suggests. This works provides some guidelines on how to obtain results from a combined VSM/SNA analysis. We have shown how it is particularly useful for a) strengthening the diagnostic power of the VSM by studying the dynamics of the organisation in working groups; b) by identifying in a more robust way, many of the pathologies in the way of managing complexity that has been described by other researchers in the field. We are aware that so far we have suggested a set of guidelines for the combined analysis; and that these are prone to improvement and further structuring, after further experimentation.

In this work, the combined use of VSM and SNA joining the strengths of quantitative and interpretive systems analysis tools. It also presents the VSM as an adaptive, flexible framework able to represent the dynamics of an organisation from individual to team levels, a position that challenges previous criticisms of the VSM as a functionalist, mechanistic approach undermining the relevance of individuals and teams (e.g. Flood and Jackson, 1991). It then provides clear foundations for new areas of development and research on the use of the VSM and other approaches to deal with organisational complexity.

The integration of VSM and SNA in this work suggest the feasibility of the combined use of tools to open a route for innovative research in the identification of organisational pathologies and in general, more robust organisational diagnostics. The emergent availability of high computational power and specialized software allowing the use of meta-networks (combining networks of resources, tasks, knowledge, individuals. e.g.

Organizational Risk Assessment- ORA; Carley & Reminga, 2004); in combination with the VSM could provide another strong route for the analysis of dynamic and structural complexity.

Additional improvements in the analysis could include real-time text-context analysis to monitor the relevance of communications as illustrated by Carley et al (2007). The combined features of the SNA, VSM and ORA can also bring an opportunity to continue with the development in the measure and design of self-organized structures, particularly when the variables to consider are the connectivity of individuals in the execution of tasks, distance to the task and knowledge, and specialization as described by Arcaute et al (2008).

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APPENDICES

Appendix A. Organizational Pathologies [1]

Table 1: Organizational Pathologies

I. Identity Pathologies (RE & AR)		
1.1 Ill defined identity (JPR)	*Organizational identity has not been created or defined*	*The SNA does not evaluate the character (soft issues) of nodes or clusters – Identity* *Measure: N/A*
1.2 Lack of alignment between organisational tasks and	*The organisation perform tasks some of which do not correspond to the*	*Not clear enough what to observe here in terms of SNA*

[1] (Adapted by the authors using their own experience from Espejo & Reyes (2011, p. 233-355), Perez-Rios (2012), and Hoverstadt (2009, P. 54-60)

perceived identity (RE&AR)	*espoused identity*	*Measure: N/A*
1.3 Purpose in use different to the espoused purpose (RE&AR)	*Espoused purpose differ from 'purpose in use' (the one explained by the tasks performed)*	*Not clear enough what to observe here in terms of SNA* *Measure: N/A*
1.4 Regulatory activity acting as a primary activity (RE&AR)	*A regulatory function starts behaving as a primary function and selling services to external as well as internal clients*	*SNA can suggest a situation like this if the regulatory systems present excessively high values of connectivity (probably High out-degree) and many contacts with the exterior (environment)* *Measure: Centrality Degree; Out-degree*
1.5 Underdeveloped primary activities (RE&AR)	*Organisational identity dominated by some primary activities at the expense of a few others left behind*	*Not clear enough what to observe here in terms of SNA* *SNA may suggest this situation if one/few some primary activity(ies) present(s) less connectivity than the average for the S1, particularly the values of connectivity with S3* *Measure: consolidated degree for each S1; connections with meta systemic functions*
1.6 Emergent virtual organisation (RE&AR)	*The emergent virtual organisation that dominates the organisational identity*	*Not clear enough what to observe here in terms of SNA* *Measure: N/A*
1.7 Negative synergy (RE&AR)	*The organisational level does not add value to the operational level*	*Not clear enough what to observe here in terms of SNA* *Measure: N/A*
1.8 Inconsistent Primary activity (RE&AR)	*The primary activity works for inconsistent purposes*	*Not clear enough what to observe here in terms of SNA.* *Measure: N/A*
1.9 Liquid Identity (RE&AR)	*Due to quick, constant environmental changes, the organisation finds difficulty to keep services or products identities for a long time. The organisation as networks of companies providing outsourced services. Systems 1 as 'viable core learning teams' rather than 'product teams'*	*Not clear enough what to observe here in terms of SNA* *Measure: N/A*
1.10 Institutional Schizophrenia: (JPR)	*Two or more identity conceptions produce conflict within the organization*	*Not clear enough what to observe here in terms of SNA* *Measure: N/A*
***II. Operational Pathologies:** These are related to the way viable systems emerged and constituted recursive levels of organisation. Mostly with the way each system one handles complexity and its interaction with upper and lower levels of organisation (Authors)*		
2.1 Non-existence of vertical	*Its absence drives the organization to*	*The lack of vertical unfolding can be detected*

unfolding (JPR)	*the impossibility to deal with the total variety it faces*	*using algorithms to identify components. It would be expected to find in the network embedded components, each corresponding to a different level of recursion).* *Measure: Component Count (strong & weak)*
2.2 Lack or recursion levels (JPR)	*Vertical unfolding is accomplished but the first level of recursion is left empty leaving part of the environment unattended*	*This can be observed by checking the links with the environment within each identified component in the network. It would be expected to find components not connected with the environment if the pathology exists.* *Measure: ID of connected components. Strong/weak / giant) and their connections with the environment (Centrality Degree & Degree distribution)*
2.3 Lack of recursion levels (middle levels) (JPR)	*Vertical unfolding is accomplished but the middle recursion levels are left empty. This leaves the corresponding variety to be handled by the previous or next recursive level (which will cause further problems) or unattended.*	*This can be identified as before but significant connectivity between elements form the component connecting with the environment and the one(s) not connected directly with the environment would also be observable* *Measure: Centrality Degree & Degree distribution. The ID of connected components. Strong / weak / giant)*
2.4 Entangled vertical unfolding (JPR)	*Various interrelated level membership. Inadequate integration/communication between recursion levels when multiple memberships are present*	*This could be observed with the identification of cliques, communities and/or modularity. The overlapping situation can be detected by the repeated occurrence of members in different communities/cliques.* *Measure: Clustering algorithms, clique –with overlapping - recognition algorithms (e.g: Palla et al (2005)*
2.5 Weak System 1 (RE&AR)	*System 1 not operating well: not recognised as a System 1, poorly managed, lack of self-organisation, lack of autonomy, lack of understanding of the local environment.*	*It can be suggested by poor internal connectivity within the S1 in addition to other symptoms of related pathologies such as strong connections from meta-systemic functions (S2-S5) and poor connectivity with the environment. A community with poor/none connections with the rest of the network can also insinuate it.* *Measure: Centrality. Consolidated In/out degree for the S1 (we would expect poor connectivity).*
2.6 Dominance of S1-weak meta-system (JPR)	*The power of S1 is not handled within the limits set by the meta-system.*	*Opposite to the Underdeveloped S1. A relative high centrality value for the S1 may suggest the occurrence of this form the SNA.* *Measure: Centrality, In and Out-Degree and presence of connections with S2-3.*
2.7 Disjoined behaviour within S1s (JPR) *The Yo-Yo (PH)*	*A lack of adequate interactions between the S1s lead to fragmented behaviour*	*SNA can describe the connectivity among the different S1s by observing the connections and values of connectivity among the different*

	Unbalance between autonomy and cohesion. Fragmented identity. Oscillating between centralized vs. devolved authority.	*groups/systems/ communities* *Metrics: Centrality. Consolidated degree for the S1s. The presence and high value of connectivity among the S1 (strength of the links)*
2.8 Autopoietic beast (JPR)	*Elemental operative units within the S1 behave as if their individual goals were the only reason for being. They ignore the need to harmonize their individual goals within an integrated S1*	*SNA can suggest his presence by identifying activity in the S1 (relatively high values of connectivity) in an almost isolated group* *Measure: Identification of Groups. Relatively high connectivity within the group*
III- Meta-systemic pathologies (Authors): *These pathologies relate with the way the meta-systemic roles operate and interact, their constraints and resulting organisational misfits*		
System 2		
2.9 Weak System 2 (RE&AR)	*Misaligned purposes and values between stakeholders and policymakers. Poor coordination and cohesion: different qualities from products and services from Systems 1s. Lack of synergy between Systems 1 due to poor, restrictive management in the middle*	*Not clear enough what to observe here in terms of SNA* *Measure: N/A*
2.11 Authoritarian S2 (Authors)	*System shifts from a service provider to an authoritarian controller*	*This can be suggested by high values of out-degree towards S1* *Measure: Centrality. Consolidated Out degree (S2 to S1)*
2.12 Lack of information systems (JPR)	*Some of the information systems are inexistent or inappropriate.*	*Not clear enough what to observe here in terms of SNA - However, the lack of communication channels connecting to VSM systems could suggest this pathology.* *Measure: N/A*
2.13 Fragmentation of information systems (JPR)	*Information systems are in place but they are not interconnected*	*Not clear enough what to observe here in terms of SNA* *Measure: N/A*
2.14 Lack of key communication channels (JPR)	*Certain communication channels that should exist are not in place, they do not work or their design is inappropriate.*	*Identifiable through the observations of links between the different groups/communities* *Measure: Graph, the linkage between groups, cliques, and/or communities; reciprocity.*
2.15 Insufficient Communication Channels Capacity. (Authors)	*Insufficient communication channels capacity.*	*Identifiable through the observations of links between the different groups/communities. The existing links do not reflect the connections suggested by the VSM and/or the values of connectivity between some/all the different systems are too low.* *Measure: Graph, the linkage between groups, cliques and/or communities; reciprocity.*

2.16 Lack of sufficient algedonic channels (JPR)	*Necessary algedonic channels are not present or if exist, they are poorly designed and/or do not work properly*	*Inexistence of communication channels between the S1 and S5 (Note: This channel is used just when required under extreme circumstances – therefore the measurement is not about the strength but the existence of such communication channel)* *Measure: Graph, the linkage between S5 and S1s.*
2.17 Communication channels incomplete or with inadequate capacity (JPR)	*Necessary communication channels do not have the capacity/ functionality for transmitting information (Transducer, channel capacity, sender-receiver in both directions)*	*The connections between the different groups are incomplete, weak or not present as suggested by the VSM. The SNA graph can describe the existence of these connections in their directionality and strength.* *Measure: Graph, Consolidated values of in/out degree for All the VSM systems*
2.18 Weak connection between system 1 and 2 (Authors)	*Necessary communication with the coordination centre is not present or weak*	*Measure: Graph, Centrality in-out degree between S1 and S2.*
Systems 3 and 3*		
2.19 Control Dilemma (RE) *(PH)*	*Managers dealing with far more complexity than they should, resulting in poor performance. Information overload syndrome* *Micro-management*	*Overwhelming values of in-degree and poor values of out-degree (indigestion of information?) in meta-systemic functions, principally in S3* *Measure: Graph. Centrality (in/out) Degree*
***2.20** Weak System 3 (RE&AR)*	*Resource and functional centralisation. Corporate intervention* *Poor operational alignment of a centralised function with operational activities* *Managers bypassing lower level operational managers* *or vice versa.*	*Poor values of Betweenness and in/out degree for the manager could insinuate this situation. Graph: poor or no connection with S1* *Measure: Graph. Centrality (in/out) Degree*
2.21 Inadequate management style (JPR)	*System 3 intervenes inadequately in the affairs of S1*	*Not clear enough what to observe here in terms of SNA* *Measure: N/A*
2.22 Schizophrenic S3 (JPR)	*Conflict arises among the functions of S3 due its inclusion in the system (operations) and the meta-system (management)*	*Not clear enough what to observe here in terms of SNA* *Measure: N/A*
2.23 Hypertrophy of S3 (JPR)	*S3 concentrates much of the activity that should be carried out by S3*, S2 and S1*	*S3 May present values of centrality over the average for the VSM systems; together with weak links with the S2 and S1. It could also be reflected by poor Betweenness – poor connection with the well-connected nodes of each system (S1 and S2).* *Measure: Graph. Centrality (in/out) Degree,*

		Betweenness
2.24 Weak System 3 (RE&AR)* *Lack of sufficient development of S3* (JPR)*	*Poor or inexistent monitoring systems* *Micromanagement: monitoring and reporting at the wrong level.* *Lack of monitoring activity conduces to lack of action –due to ignorance- when there are inappropriate behaviours in S1*	*SNA can provide information about the existence and strength of links between S3 and S1.* *Measure: Graph, linkage with S3**
2.25 Weak connection between S3 and S1 (JPR)	*Operational units work separately without being integrated by S3*	*SNA can provide information about the value of the connectivity between the S3 and S1.* *Measure: Consolidated degree in/out degree between the S3 and S1; Graph*
2.26 Weak connection between system 2 and 3 (Authors)	*Poor or inexistent exchange of information between S2 and S3 may conduce to the generation of an intrusive or a not well informed S3*	*SNA can suggest this situation if the values of connectivity between S2 and S3 are low or the communication channel is inexistent.* *Measure: Graph, a linkage between S2 and S3.*
System 4		
2.27 Weak System 4 (RE&AR) *Headless Chicken (JPR)*	*Weak stretching archetype – poor System 4* *System 4 is missing or if it does exist it does not work properly*	*SNA can confirm the existence of this function as a group/community. It also can detect connections with the outside - reflected as connections with individuals peripheric to the main network. Information about affiliation may confirm the external nature of these links. (if detected as a community) or from the different operative units.* *Measure: Graph, communities/cliques, Degree distribution*
2.28 Dissociation of S3 and S4 (JPR)	*The homeostat S3-S4 does not work properly. They do not communicate and interact with each other properly.*	*The SNA can identify poor or non-connections between these two groups/communities and it also would present information about the strength of the communication flow among these groups* *Measure: Graph, Linkage among s3 and S4.*
System 5		
2.29 Lack of meta-system (JPR)	*Insufficient or inexistent definitions of identity and purpose. A weak or inexistent meta-system shifts the balance between "there and then" and the "here and now" management activities towards the "here and now" leaving adaptation-oriented activities unattended. Inadequate links exist between the recursion levels*	*SNA can't identify identity.* *SNA can identify the existence of a group and the affiliation of individuals to it.* *Measure: Graph. Centrality Degree*
2.30 Inadequate representation	*Poor connection within Systems 5s organizations pertaining to different*	*SNA can provide information about the affiliation*

vis-à-vis higher levels (JPR)	*recursion levels within the same global organization*	*of individuals to this group* *Measure: Communities/cliques/groups*
III. Meta-systemic Interactions		
3.1 Poor (or no) differentiation of primary and secondary activities (JPR)	*Operational and management activities (primary and secondary/ systemic and meta-systemic) are not clearly differentiated*	*Not clear enough what to observe here in terms of SNA* *Measure: N/A*
3.2 Collapse of System 5 into System 3 (non-existing metasystem) (JPR)	*System 5 Intervenes undesirably in the function of System 3*	*This can be observed by looking at the conformation of communities in the network and its connectivity. In this case, it would be expected to find strong direct connectivity between S5 and the operative units (S1)* *Measure: Graph, the linkage between S5 and S1 (values above average – graph)*
3.3 Poor governance due to over empowered S1s (Authors)	*S1 control most of the resources; their representatives make the strategic decisions, with not enough involvement from the next recursive level (e.g. the national government in a regional focused network)*	*Not clear enough what to observe here in terms of SNA* *Measure: N/A*
3.4 Organizational autopoietic beast (JPR) *Organisational Cancer (PH)*	*The uncontrolled growth and activity of some individual parts of the organization put in risk the viability of the whole.* *Uncontrollable growth of a group of activities – support activities growing uncontrollably*	*SNA can identify the groups with high internal values of connectivity (suggesting high activity). Also it can detect how poorly connected is to the S2-5.* *Measure: variation in the affiliation to a group, its connectivity and density of links (all values increasing above average)*